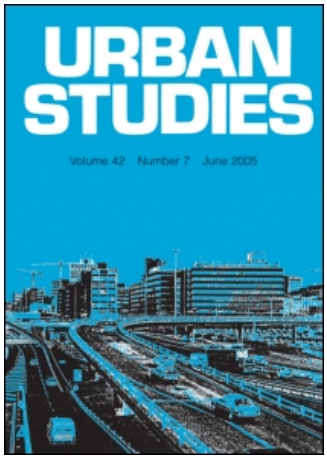

Urban Studies
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713449163

Estimating the public's value for urban forest in the Seoul metropolitan area of Korea: A contingent valuation study

Seung-Jun Kwak; Seung-Hoon Yoo; Sang-Yong Han

Online Publication Date: 01 October 2003
To cite this Article: Kwak, Seung-Jun, Yoo, Seung-Hoon and Han, Sang-Yong (2003) 'Estimating the public's value for urban forest in the Seoul metropolitan area of Korea: A contingent valuation study', Urban Studies, 40:11, 2207 - 2221
To link to this article: DOI: 10.1080/0042098032000123259
URL: http://dx.doi.org/10.1080/0042098032000123259

Urban Studies, Vol. 40, No. 11, 2207–2221, October 2003

Carfax Publishing
Taylor & Francis Group

Estimating the Public's Value for Urban Forest in the Seoul Metropolitan Area of Korea: A Contingent Valuation Study

Seung-Jun Kwak, Seung-Hoon Yoo and Sang-Yong Han

[Paper first received, May, 2002; in final form, March 2003]

Summary. Urban forests have various environmental benefits that contribute to the quality of urban life. These values, however, have been underestimated or have never been reflected in urban development planning in Korea. As a result, a number of forests in urban areas were either partly or wholly destroyed without their public's value being assessed explicitly. The objective of this paper is to estimate the value attached by the public to Kwanggyo Mountain in the Seoul Metropolitan Area of Korea using a contingent valuation survey, aimed at providing policy-makers with useful information to make an informed public decision in urban development planning. The survey was carefully designed and implemented to meet a number of recommendation rules suggested in the literature. The overall results show that the respondents received the hypothetical scenario well and would be willing to pay a significant amount for the proposed programme of conserving the mountain. The total value stated by the public amounted to approximately 3.77 billion Korean won (US$2.9 million) per year. This quantitative information can be used in policy-making process for urban development plans.

1. Introduction

Urban forests provide multiple environmental and social benefits, including protection against soil erosion and natural hazards, ground-water protection, as well as amenity values (OECD, 1999). Among these benefits, amenity values in particular, have been emphasised as contributing to the quality of urban life (Robinette, 1972; Grey and Deneke, 1978; Miller, 1997). Most of these values are non-priced environmental benefits including wilderness, pleasant landscape and potential recreational opportunities.

Nevertheless, these values have been underestimated or have never been reflected in urban development planning in Korea. For the past 30 years, several forested areas in the Seoul Metropolitan Area (SMA) have been threatened by urban development

Seung-Jun Kwak and Sang-Yong Han are in the Department of Economics, Korea University, 5-1 Anam-Dong, Sungbuk-Ku, Seoul, 136-701, Korea. Seung-Jun Kwak—Fax: + 82 2 3290 2535. E-mail: sjkwak@korea.ac.kr. Sang-Yong Han—Fax: + 82 2 928 4948. E-mail: hansy@korea.ac.kr. Seung-Hoon Yoo is in the School of Economics and Business, Hoseo University, 268 Ansea-Dong, Cheonan, Chungnam, 330-180, Korea. Fax: + 82 41 560 8304. E-mail: shyoo@office.hoseo.ac.kr. *This work was supported by Korea Research Foundation Grant (KRF-2001-042-C00072). The authors wish to thank three anonymous reviewers for their useful comments. All errors remain the authors' responsibility.*

0042-0980 Print/1360-063X On-line/03/112207–15
DOI: 10.1080/0042098032000123259

projects, which had been planned to alleviate the shortage of housing supply and to decentralise the population of Seoul, the capital of Korea. As a result, a number of urban forests were either partly or wholly destroyed without their public's value being assessed explicitly. This deforestation in the SMA has been deeply connected with economic growth-oriented land management policies, which will be explained in the next section.

It was not until the early 2000s that these ill-considered land developments became a serious social issue in all potential development areas in the SMA, whose population is about half of the national population. Conflicts between the government and civic groups led to subsequent submissions of civil suits in 2001. As there is no room for compromise under the current land management policy, the policy-makers are currently considering other measures appropriate to implement environment-friendly urban development and further achieve urban sustainability.[1]

The main objective of this paper is to estimate in monetary terms the public's value attached to urban forests in the metropolitan area of Korea. This has been done in order to provide policy-makers with useful information to make an informed public decision in urban development planning. To this end, the paper reports the findings of a contingent valuation (CV) study in a developing-country setting where the economic valuation of urban forests remains scarce. The message of the paper is all the more useful because, to the best of the authors' knowledge, there have been few developing-world applications of the CV method to quantifying the public's value of urban forests.

The remainder of this paper is organised as follows. Section 2 describes some issues relevant to urban deforestation in Korea. Section 3 presents an overview of the estimation method employed in this paper. Section 4 reviews methodological issues on design and survey. Section 5 explains a model to derive the respondent's willingness-to-pay for conserving Kwanggyo Mountain. Section 6 discusses the results. Some concluding remarks are made in the final section.

2. Some Issues Relevant to Urban Deforestation in Korea

2.1 Urbanisation and Land Development Planning in Korea

As Korea moved quickly towards modernisation and industrialisation from the early 1960s onwards, urbanisation and rural depopulation accelerated and the urban share of the population rose rapidly, reaching almost 87.6 per cent by 1999. The SMA, in particular, which consists of 32 cities including Seoul and covers an area of 11 705 sq km (about 11.8 per cent of the national area), has grown rapidly due to the drift of population. The population amounted to 21.3 million (about 46.2 per cent of the national population) in 2000, as shown in Table 1. Residents in the SMA have consequently gone through a number of urban problems like traffic jams, pollution, the supply shortage of housing and infrastructure, as have other metropolitan areas in the world.

This rapid change in the SMA subsequently placed enormous pressures upon the limited land resources. The outstanding features of urban development planning in Korea had two conflicting aspects in the 1990s: increasing the density of the urban structure and expanding the urban area.

Increasing urban density, viewed as a general solution for achieving sustainable development in an urban environment, has been

Table 1. Urbanization trends in the Seoul Metropolitan Area

	Population (1000 persons)		Population density (persons/sq km)	
Year	Nation	SMA[a]	Nation	SMA[a]
1970	31 435	8 879	320	776
1975	34 679	10 914	351	935
1980	37 407	13 281	378	1 137
1985	40 420	15 803	408	1 354
1990	43 390	18 574	437	1 588
1995	44 554	20 159	449	1 727
2000	45 985	21 258	462	1 816

[a]SMA denotes Seoul Metropolitan Area.
Source: Korea National Statistical Office (2001).

used to reduce transport costs and the use of natural resources and energy in developed countries (Lahti and Rauhala, 1994). These projects as forms of infill (for example, rebuilding and redevelopment) in the residential areas of Seoul, however, have virtually ceased to be effective in stabilising housing prices and increasing housing supply.

A collateral measure to build satellite towns on the periphery of Seoul was faced with a chronic shortage of construction sites. To resolve this problem, the government finally renewed the national land-use planning system in 1993; the main substance of this was to introduce 'quasi-agricultural (forest) areas' in the zoning system.[2] The introduction of quasi-agricultural areas has greatly increased land supply for development projects providing about 300 000 houses and more than 100 sq km of factory sites during the period of 1994–99. It was intended to increase the supply of land by switching the land-use restriction system from positive to negative: the original policy, where the highest priority was given to conservation and development came second, was reversed.

During the rapid expansion of urban areas, little attention was, however, paid to environmental planning for land development, partly because of economic efficiency oriented land-use policies. Reckless development projects in urban areas incurred various social costs due to lack of infrastructure, encroachment on superior farmland, environmental pollution and impairment of landscape.

2.2 Deforestation by Reckless Land Development in the SMA

Development pressures in new town areas were especially concentrated in green spaces at low densities with greater land requirements. For the past 10 years, new town development projects, designed to alleviate the shortage of housing supply, have deforested a number of urban forests in the SMA. Table 2 shows deforestation trends nationally and in the SMA during the past two decades (1980–2000). The deforestation rate in the SMA has been consistently higher than the national rate during this period. Note that there was a drastic increase in the deforested area in the SMA during the 1990s. This outcome results from urban planning policies, as stated above.

Table 2. Deforestation trends nationally and in the SMA

Period	Deforested area (sq km)		Deforestation rate (percentage)	
	Korea	SMA[a]	Korea	SMA[a]
1980–85	367	74	0.56	1.24
1985–90	551	74	0.84	1.26
1990–95	241	386	0.37	6.64
1995–2000	298	118	0.46	2.18

Note: The base forested area nationally and in the SMA was, respectively, 65 678 sq km and 5953 sq km in 1980.

[a]SMA denotes the Seoul Metropolitan Area.

Source: Korea National Statistical Office (2001).

In January 2000, the government proposed a 'planning first and development after' system as the basic direction for national land-use management. Nonetheless, if there is no explicit valuation made of the public's values attached to urban forests, these values are not likely to be reflected in the policy-making process concerning land development projects in urban areas. Thus, these values need to be assessed in monetary terms.

At present, many municipalities in the SMA have not yet specified their urban forests management programme and many forested areas are considered as left-over areas awaiting more intensive use. In the current situation, it is quite important to evaluate the public's value of urban forests in the SMA.

3. Estimation Method

The cornerstone economic principle in assessing the public's value of a proposed programme for preventing environmental damage is the concept of 'willingness-to-pay' (WTP) (Brent, 1995).[3] This concept rep-

resents the amount that people would be willing to pay for avoiding specified environmental damage. The WTP concept makes strong intuitive sense. If an additional unit of deforestation in an urban area—for example, causes a person $10 worth of extra expenditure, then that person would normally be willing to pay up to $10 to avoid such an increase in deforestation.

This paper employs a survey approach called the CV method to estimate the respondent's WTP for conserving Kwanggyo Mountain in the SMA. CV is a standardised and widely used stated preference technique for estimating WTP for use or non-use values of public goods (Mitchell and Carson, 1989).

The CV method involves constructing a hypothetical market or referendum scenario in a survey. The proposed increase (if respondents pay) or decrease (if respondents do not pay) in the quantity or quality of environmental goods is communicated to respondents in words and with visual aids. Next, respondents are informed of how much they should pay for the proposed quantity or quality. Then the provision rule is clear: if you agree to pay, you get the proposed quantity or quality; if you do not pay, you remain at the current quantity or quality level. Respondents use the hypothetical market to state their WTP or vote for or against a public programme at a particular tax price (Loomis, 1996).

A blue-ribbon National Oceanic and Atmospheric Administration (NOAA) Panel concluded that the CV method can produce estimates reliable enough to be the starting-point for administrative and judicial determinations and presented several recommendations (Arrow *et al*., 1993). The validity and accuracy of a CV study will be enhanced if people are familiar with the issues, if the issues and method of provisions and payment are meaningful to people, if professional interviews are used and if other conventions suggested by the NOAA Panel are followed (Fisher, 1996). The present study meets the conditions, which will be discussed in detail in the next section.

4. Methodological Issues on Design and Survey

4.1 Definition of Objects to be Valued

The proposed programme to be valued is a commitment using a variety of policy instruments by the government to do its part in the preservation and management of Kwanggyo Mountain, which is a potential development area. The main instruments include purchase of private land, assignment to a forest reserve protected from development pressure and the formation of a forest park.

Kwanggyo Mountain is 582 metres high and is located on the border of Yongin and Suwon towns in the SMA, whose green area covers an area of 8.71 sq km. There exist on the mountain 633 species of plants, 25 species of birds and numerous wild animal and insect species, including the porcupine and the firefly. In addition, the mountain not only provides recreational space for exercise, forest-bath (strolling and resting in the forests for one's health care) and ecotourism for residents in the SMA, but also creates a positive image for the two towns. In spite of the public's value, a development project including an area of 0.33 sq km at the foot of the mountain was proposed by the Yongin local government in 2001; this has been delayed due to strong protests from environmental and civic groups and some landowners.

In designing a CV survey, a scenario should offer respondents information about the characteristics of the specific goods and the context which meets the requirements of understandability, plausibility and meaningfulness so that it can enhance the credibility of the survey and make it more likely to produce reliable results. This process is particularly important when the object to be valued is unfamiliar to the respondents. These conditions were addressed by taking the following two measures before the key WTP questions.

First, care was taken that respondents accepted the general situation of the hypothetical scenario. This was implemented by showing the specific urban forest area of

Kwanggyo Mountain and explaining the background information on this area and the current issues of development pressure for other land uses (such as housing or construction sites). Secondly, a detailed description was presented of what is known about the likely effects of the hypothetical conservation programme and, more importantly, what is likely to happen if nothing is done. This description detailed the beneficial effects anticipated by the conservation programme for Kwanggyo Mountain. The effect categories included the absence of development pressure, the settlement of conflicts around the two towns and the improvement of the Kwanggyo Mountain ecosystem.

4.2 Sampling and Survey Methods

A survey of households was implemented for a month, beginning 16 December 2001. The study area for this research was restricted to Seoul, where the population equals about half of the population in the SMA. The survey was administered to Seoul residents, heads of household or housewives between 20 and 65 years of age. A random sampling to obtain a representative sample of this population was conducted by a professional polling firm (Dongseo Research, Inc.) located in Seoul.

The survey could have been conducted by personal interviewing, telephone interviewing, or by mail. Personal interviews were employed for the CV survey for cultural and practical reasons. First, it was felt that randomly chosen Korean citizens would be even less likely than Europeans and Americans to be familiar with the idea of supplying unprompted values for proposed public goods if they were confronted with a telephone interview or mail survey questions. However, personal interviews with well-trained interviewers can not only offer the most scope for detailed questions and answers, but can also elicit reliable estimates of values (Yoo and Chae, 2001). In this context, 50 of the most experienced and best-educated of the polling firm's interview experts were selected to conduct the interviews and they were given a thorough briefing. Secondly, a telephone interview was the least-preferred method because conveying information about the good being considered may be difficult over the telephone, partly because of the respondent's limited attention-span. Finally, a mail survey might be argued to produce low response rates because it fails to attract enough attention against competing stimuli (Green and Tunstall, 1999). In addition, mail surveys are rarely used in Korea because they suffer from severe non-response bias and extremely low response rates; thus it seemed especially risky to use mail surveys in the context of Korea.

4.3 The Survey Instrument

The survey instrument (questionnaire) was set up with the assistance of experts at the polling firm. The final survey questionnaire consisted of three different parts. The first part of the questionnaire included instructions for answering, the definition of urban forests and several questions concerning general attitudes towards urban forests and recent deforestation in the urban area. To make the survey interesting to non-users of Kwanggyo Mountain, questions were included about the respondent's use of the 13 other urban forests located in Seoul (Bukhan Mountain, Nam Mountain and so on).

The second part consisted of descriptions of Kwanggyo Mountain and the proposed programme to be valued, questions about the use of Kwanggyo Mountain, the situation in which the respondent should imagine himself/herself and the key WTP questions for the proposed programme. Respondents were specifically presented with substitutes for the goods to be valued in this study. In other words, other mountains were considered as possible substitutes. The final part dealt with the socioeconomic characteristics of the respondent (for example, age, sex, income and so on).

4.4 The Elicitation Method

Two question formats, dichotomous choice (DC) and open-ended, have been mainly

used in the CV literature. The elicitation format used in this study is a DC question according to the recommendation of the NOAA Panel, which strongly endorsed a DC question rather than an open-ended question.

The DC model has held great appeal since it was popularised by Hanemann (1984). DC questions are designed to mimic a real market situation, where a random sample of the population is asked a 'yes' or 'no' question identifying their willingness to contribute a specific amount towards the conservation programme for Kwanggyo Mountain.

Pre-testing for the survey questionnaire is an essential procedure in CV before the survey is conducted. The questionnaire was pretested twice, using 30 residents in Seoul. The results of pre-testing were used to refine the range of bid amounts for the DC WTP questions and to diminish response errors originating from the respondent's misunderstanding of the main description and questioning in the survey. Through the pretesting, a set of the final bids used in this study was obtained. They comprised 12 bids from 1000 to 12 000, won in 1000 increments.

4.5 The Payment Vehicle

In CV studies, it is quite important to choose an appropriate payment vehicle because selection of payment vehicles can influence responses to CV questions (Rowe and Chestnut, 1983). The payment vehicle used for this study was the urban planning tax, which is likely to be familiar to most respondents. It also has a plausible connection with the conservation programme for Kwanggyo Mountain. The respondents were informed of how the payments were to be collected in the WTP elicitation question.[4] The WTP question was

> Would your household be willing to pay a given amount more for the next five years in higher urban planning tax each year for a programme of conserving Kwanggyo Mountain from a recent development project, provided that the success of this programme is guaranteed? If the majority of people are not willing to pay, the mountain would not be conserved. If the majority of people agree to pay, the mountain would be conserved. In addition, remember the fact that the deforestation of the mountain is one of many environmental problems in the SMA and the disposable income of your household is limited.

Regarding the definition of the costs that the households themselves were likely to bear, a provision point mechanism was used. Respondents were told that

> The amount you indicate will tell us what it is really worth to your household to have the programme implemented. If the programme actually costs less than people are willing to pay, you would only have to pay what it would cost. If the programme turns out to cost more than people are willing to pay, it would not be implemented.

The information given to respondents about all aspects of the hypothetical market, together with such information as is provided on the good being valued, constitutes the framing of the good.

5. A WTP Model

The utility difference model used by Hanemann (1984, 1989) provides one method for developing Hicksian compensated measures from DC-CV data.[5] This section focuses on the theoretical aspects of DC-CV surveys based on the utility difference model. The observed discrete choice response of each individual is assumed to reflect a utility maximisation process.

The indirect utility function, ν, for each respondent depends on income along with individual characteristics and the quality of objects to be valued. The respondent will pay the increased bid amount to accept the proposed programme if

$$\nu(1, m - A; S) + \varepsilon_1 \geq \nu(0, m; S) + \varepsilon_0 \qquad (1)$$

or

$$\Delta v(A) \equiv v(1, m - A; S) - v(0, m; S) \geq \varepsilon_0 - \varepsilon_1 \quad (1')$$

where, state 0 represents no existence of the proposed programme and state 1 represents existence when the respondent must pay the stated bid amount, A, and income is m. Random elements which influence the respondent's indirect utility function are defined by ε_0 and ε_1, which are independent and identically distributed random variables with zero means. Other observable attributes which influence preferences are represented by S and also appear in the utility difference specification.

Each respondent will maximise utility by answering 'yes' and will agree to pay the bid amount, if the difference in indirect utility (Δv) from paying and having continued existence of the proposed programme is positive. Using equation (1′), the utility difference model yields the single equation binary response model specification where the probability of a 'yes' response is a random variable whose probability is given by

$$\Pr\{\text{response is 'yes'}\} = \Pr\{\Delta v(A) \geq \eta\} = F_\eta[\Delta v(A)] \quad (2)$$

where, $\eta = \varepsilon_0 - \varepsilon_1$ and $F_\eta(\cdot)$ is the cumulative distribution function (cdf) of η. A 'yes' response is observed when $\Delta v \geq 0$, while a 'no' response to the CV question is observed when $\Delta v < 0$. WTP (hereafter denoted C) is recognise d as a random variable with a cdf defined here as $G_C(A)$. As an alternative to expression (2), the probability can be expressed as

$$\Pr\{\text{response is 'yes'}\} = \Pr\{C \geq A\} \equiv 1 - G_C(A) \quad (3)$$

Thus, we obtain

$$1 - G_C(A) \equiv F_\eta[\Delta v(A)] \quad (4)$$

This result indicates that the fitting of the binary response model (2) can be interpreted as estimating the parameters of the distribution function $G_C(\cdot)$.

The DC-CV question asks the respondent to accept or reject a suggested bid for the proposed programme. Let $i = 1, \ldots, N$ be the index for each respondent in the sample. When each respondent is presented with a suggested bid, there are two outcomes: (a) answer is 'yes'; (b) answer is 'no'. Given the assumption of a utility-maximising respondent and a sample of N respondents where $G_C(A_i)$ is the probability of a 'no' response to a suggested bid to the ith respondent, A_i, the log-likelihood function takes the form

$$\ln L = \sum_{i=1}^{N} \{I_i^Y \ln [1 - G_C(A_i)] + (1 - I_i^Y) \ln G_C(A_i)\} \quad (5)$$

where, the value of I_i^Y is one if the ith respondent's answer is 'yes' and zero otherwise.

Following the practice of former studies, formulating $F_\eta(\cdot)$ as logistic cdf and combining this with $\Delta v = a - bA$ yields

$$G_C(A) = [1 + \exp(a - bA)]^{-1} \quad (6)$$

Then, the WTP is defined for the change from state 0 to state 1. If the proposed programme is beneficial to respondents, their WTP must be greater than or equal to zero. Hanemann (1984) provides the following formula to calculate the truncated mean WTP (hereafter denoted C^{++}).

$$C^{++} = \int_0^\infty [1 - G_C(A)]dA = (1/b) \ln [1 + \exp(a)] \quad (7)$$

If some respondents view deforestation by development projects on Kwanggyo Mountain as beneficial, then their WTP for the proposed programme could be negative—i.e. they would need to be compensated for implementing the proposed programme. To allow for this, an alternative formula provided by Hanemann (1989) can be used. Thus, when the WTP can be positive or negative, the mean (hereafter denoted C^+) from the utility difference model is calculated as

$$C^+ = E(C) = \int_0^\infty [1 - G_C(A)]dA - \int_{-\infty}^0 G_C(A)dA = a/b \quad (8)$$

Table 3. Distribution of 'yes' votes at each bid amount

Bids (won)	Sample size	'Yes' votes	Percentage of 'yes' votes
1 000	50	33	66.0
2 000	50	22	44.0
3 000	50	15	30.0
4 000	50	14	28.0
5 000	50	16	32.0
6 000	50	7	14.0
7 000	50	5	10.0
8 000	50	4	8.0
9 000	50	4	8.0
10 000	50	4	8.0
11 000	50	4	6.0
12 000	50	3	6.0
Total	600	127	21.2

To estimate the model with covariates, in former equations, a is simply replaced with $a + \boldsymbol{x}_i'\beta$, where $\boldsymbol{x}_i$ is a vector of covariates and β is a vector of parameters to be estimated.

6. Results

6.1 Survey Results

A total of 648 personal interviews were administered by 50 trained interviewers. The survey yielded 600 useable questionnaires, exclusive of 48 which had item non-responses or were rated by the enumerator as being of poor quality. The data seemed to be representative of the whole population—i.e. the residents of Seoul—according to sex and age distribution, education and place of residence.

Of the respondents, 575 (95.8 per cent) viewed the conservation of urban forests as being more or equally important, compared with other environmental problems like water and air pollution. A total of 307 respondents (51.2 per cent) had experienced a visit to some of the other 13 urban forests in Seoul, while only 14 respondents (2.3 per cent) had been to Kwanggyo Mountain. The main reasons for not visiting Kwanggyo Mountain were ignorance (66.8 per cent), obscurity (10.4 per cent), remoteness (6.0 per cent), the presence of substitute areas (10.3 per cent) and others (6.3 per cent). In addition, only 90 respondents (15.4 per cent) among the non-visitors had the intention of visiting there within 1–2 years. It can be concluded that most respondents were unfamiliar with Kwanggyo Mountain. Thus, the respondents' WTP for the conservation programme of Kwanggyo Mountain seems to place more weight on non-use values rather than use value.

Table 3 presents the distribution of responses, indicating the total number of respondents who stated that they would be willing to pay for the proposed programme at each bid level, ranging from 1000 to 12 000 won per year. It is evident that the percentage of 'yes' responses to the bid falls, roughly, as the bid amount increases. For example, 33 people (66.0 per cent) favoured the programme at a yearly cost of 1000 won, whereas only 3 people (6.0 per cent) approved of it at the 12 000 won level.

To sum up, a total of 127 respondents (21.2 per cent) gave a 'yes' answer and 473 respondents (78.8 per cent) gave a 'no' answer. It was not surprising that 78.8 per cent of respondents gave 'no' responses, considering that most respondents are non-visitors to Kwanggyo Mountain even though they perceived the importance of urban forest conservation.

Table 4. Estimation results of the dichotomous choice model without covariates

Variables	Coefficients
Constant	0.5114 (2.51)**
Bid[a]	−0.3283 (−8.72)***
Number of observations	600
Log-likelihood	−263.8
Wald statistic[b]	160.3
(*p*-value)	(0.000)
McFadden's pseudo R^2	0.1587
Fraction of correction predictions	0.81

[a]The unit is 1000 won.

[b]The hypothesis is that all the parameters are jointly zero and the corresponding *p*-values are reported in the parentheses below the statistic. The numbers in parentheses below the coefficient estimates are *t*-statistics, computed from the analytical second derivatives of the log-likelihood.

***indicates significant at the 1 per cent level; **indicates significant at the 5 per cent level.

6.2 Estimation Results

The DC model without covariates was estimated by using the maximum likelihood estimation method. Table 4 shows the results of this estimation. Using the Wald statistic, all the estimated coefficients are statistically significantly different from zero at the 1 per cent level. As expected, the coefficient for the bid is negative and significantly different from zero at the 1 per cent level. That is, the higher a bid, the less likely is a 'yes' response. On the whole, respondents accepted the hypothetical scenario and were willing to contribute a significant amount, on average, per household.

In addition, the DC model was estimated including covariates to examine how characteristics of the respondents or of their households affect the likelihood of approving the proposed programme. Definitions and sample statistics of variables used in the model with covariates are shown in Table 5.

Table 6 presents the estimation results of the DC model including covariates. As is the case with the DC model without covariates, the equation was significantly estimated at the 1 per cent level. Coefficients of all the variables in Table 5 are significant at the 5 per cent level and all estimated relationships are consistent with our expectations. As is the case with the DC model without covariates, the coefficient for the bid is positive and significantly different from zero. The likelihood of voting 'yes' varies according to the characteristics and the environmental attitudes of the respondents. For example, younger respondents would be more likely to vote 'yes' for the proposed programme than older respondents. The more experience of visiting urban forests and the more anxiety about the mountain the respondent has, he/she has a higher probability of voting 'yes'. In addition, previous knowledge of deforestation in urban areas by development projects, the importance of urban forests compared with other environmental problems and household income are strongly positively related to voting 'yes'.

6.3 WTP Estimates

Table 7 shows the estimates of mean WTP (C^{+}) of equation (3) and truncated mean WTP (C^{++}) of equation (2) per year per household for the DC models. Those for the DC model with covariates were together calculated for the average household, conditional on the mean of covariates in the sample. The mean WTP per year for each household was estimated to be 1558 won in the models without covariates and 1650 won with covariates, respectively. The estimates of the truncated mean WTP are 2989 won and 2775 won, respectively.[6,7] Thus, the WTP estimates are not significantly changed by adding covariates. According to the *t*-statistics, both the mean and truncated mean WTP are statistically different from zero at the 1 per cent level.

The importance of developing confidence intervals for welfare estimates is well documented in Kling and Sexton (1990). In addition, development of confidence intervals allows a more rigorous comparison of WTP estimates (Park *et al.*, 1991). As a method for constructing the confidence intervals of

Table 5. Definitions and sample statistics of variables

Variable	Definition	Mean	Standard deviation
VISIT	Dummy for the experience of visits to other urban forests in Seoul (0 = No; 1 = Yes)	0.512	0.500
KNOWLEDGE	Previous knowledge of deforestation in urban areas by land development projects (1 = Very little; 2 = Little; 3 = Much; 4 = Very much)	1.912	0.758
IMPORTANCE	Opinion about how the conservation of urban forests is important, compared with other environmental problems (1 = Very little; 2 = Little; 3 = Average; 4 = Much; 5 = Very much)	3.943	0.712
AGE	Age of the respondent (1 = <30; 2 = <40 and ≥ 30; 3 = <50 and ≥ 40; 4 = <60 and ≥ 50; 5 = ≥ 60)	2.873	1.056
DAMAGE	Degree of anxiety the respondent has about damage of Kwanggyo Mountain (1 = Very little; 2 = Little; 3 = Average; 4 = Much; 5 = Very much)	3.710	0.614
INCOME	Monthly household income after tax deduction (Unit: 10 000 won[a])	274.110	107.624

[a]At the time of the survey, US$1 was approximately equal to 1300 won.

around 500–1000 sample sizes, the non-parametric bootstrapping method is superior to the Monte Carlo simulation approach proposed by Krinsky and Robb (1986), when the true underlying distribution is logistic (Cooper, 1994). Thus, the confidence intervals around the mean and the truncated mean were calculated by using the non-parametric bootstrapping method with 5000 replications.[8]

For the DC model without covariates, the typical household's mean WTP per year ranges from 626 to 2241 won, respectively representing the lower and upper bound of the 90 per cent confidence interval of mean WTP. The lower bound of the confidence interval is greater than zero. Thus, it can be concluded that the average household in Seoul would be willing to pay a significant amount for the conservation programme for Kwanggyo Mountain. Note that the range of the WTP estimate is wider if increased certainty is desired. That is, the 90 per cent confidence interval is tighter than the 95 per cent confidence interval.

6.4 Aggregation from the Household to the Population Level

As a final exercise, the total public's value for the proposed programme was calculated to provide at least a preliminary evaluation

Table 6. Estimation results of the dichotomous choice model with covariates

Variables[a]	Expected signs	Coefficients
Constant	·	− 4.9619
		(− 4.68)***
Bid[b]	+	− 0.3802
		(− 9.08)***
VISIT	+	0.5237
		(2.17)**
KNOWLEDGE	+	0.5172
		(3.28)***
IMPORTANCE	+	0.5798
		(3.20)***
AGE	·	− 0.2327
		(− 2.01)**
DAMAGE	+	0.4863
		(2.45)**
INCOME	+	0.0033
		(2.98)***
Number of observations		600
Log-likelihood		− 233.5
Wald statistic[c]		162.6
p-value)		(0.000)

[a]The variables are defined in Table 5.
[b]The unit is 1000 won.
[c]The hypothesis is that all the parameters are jointly zero and the corresponding *p*-values are reported in the parentheses below the statistic. The numbers in parentheses below the coefficient estimates are *t*-statistics, computed from the analytical second derivatives of the log-likelihood.
***indicates significant at the 1 per cent level; **indicates significant at the 5 per cent level.

for governmental policy options.[9] As described earlier, the sample frame is representative of the population in terms of demographic aspects such as geographical regions, sex, etc. In addition, a professional survey firm implemented the administration of the survey in the field to ensure the representativeness of the sample frame. Thus, the sample values can reasonably be expanded to the general population. This was done by multiplying the estimate of the mean WTP per household by the total number of households in Seoul.[10]

Table 8 summarises the total public's value per year for the conservation programme for Kwanggyo Mountain. The total public's value per year is about 3.77 billion won (US$2.9 million), with a range from a lower bound of 1.51 billion won (US$1.16 million) to an upper bound of 5.42 billion won (US$4.17 million). These values are equal to 16.30 billion won (US$12.54 million), with a range from 6.55 billion won (US$ 5.04 million) to 23.45 billion won (US$18.04 million) at constant 2000 prices, assuming a 5 per cent discount rate and a 5-year evaluation period (2001–05). This result also indicates that the residents in Seoul place a high value on the conservation of Kwanggyo Mountain. In a practical manner, the total public's value can be compared with the conservation cost of Kwanggyo Mountain or the value of alternative land use in urban planning projects. If the conservation

Table 7. Yearly willingness-to-pay (WTP) in the dichotomous choice models

WTP	Model without covariates	Model with covariates
Mean		
WTP (won/year)	1 558	1 650
Standard error[a]	478.9	442.7
Bootstrapped *t*-value[b]	3.37	3.88
90 per cent confidence interval[b]	[626–2 241]	[814–2 324]
95 per cent confidence interval[b]	[430–2 353]	[648–2 454]
Truncated mean		
WTP (won/year)	2 989	2 775
Standard error[a]	206.8	208.6
Bootstrapped *t*-value[b]	14.42	13.16
90 per cent confidence interval[b]	[2 666–3 337]	[2 390–3 124]
95 per cent confidence interval[b]	[2 608–3 408]	[2 323–3 192]

[a]Standard errors are computed by using the delta method.
[b]The confidence intervals and the bootstrapped *t*-values are calculated by the use of the nonparametric bootstrapping method with 5000 replications.

of Kwanggyo Mountain is socially profitable, appropriate conservation policy should be made and implemented immediately.

7. Concluding Remarks

This analysis used the CV method to assess the public's value attached to Kwanggyo Mountain in the SMA by estimating a household mean WTP per year for the proposed programme. As a result of the survey, respondents accepted the hypothetical scenario overall and were willing to contribute a significant amount, on average, per household. Based on the DC model without covariates, the mean WTP for the conservation programme for Kwanggyo Mountain is estimated to be about 1558 won for the average household in the SMA, with a range (95 per cent confidence interval) from 626 to 2241 won.

In order to provide policy-makers with quantitative information useful in the policy-making process concerning the urban development project, the WTP household estimates were aggregated by multiplying WTP estimates per household by the number of households in Seoul. As a result, the total public's value attached to Kwanggyo Mountain, assuming a 5 per cent discount rate and a 5-year evaluation period (2001–05), amounts to approximately 16.30 billion won (US$12.54 million).

The results of this study provide important insights for both policy and research. For policy purposes, the results of this study provide some quantitative information as a preliminary indication of the public's value attached to the urban forest in Korea; this can be useful in the policy-making process concerning urban development planning. The main preliminary results indicate that concern about urban forests is increasing and that people are willing to shoulder the burden to conserve urban forests.

For research purposes, beyond the intrinsic interests of the results in relation to the proposed conservation programme, this paper has demonstrated the feasibility of extending the use of CV methods as a means of assessing sustainable urban development. A highly educated population and recently developed skills in standard survey sampling and interviewing techniques provide a sound foundation on which to impose the special requirements of CV studies. The latter can estimate the non-use value of the urban forest more accurately than other valuation techniques.

Table 8. Total public's value for the conservation programme

	Billion Korean won/year (million US$/year)
Lower bound	2.06 (1.59)
Medium	7.48 (5.75)
Upper bound	11.30 (8.69)

Notes

1. Urban sustainability is not just about making towns and cities more efficient in terms of their use of resources. The main aim is to improve the quality of life by providing not only affordable housing, employment opportunities and a wide range of facilities and services, but also cultural, leisure and recreational resources through green space (Banister, 1999).
2. According to the revised national land-use management law, the quasi-agricultural forest area, accounting for 26 per cent of national land, falls into one of the five classifications in the zoning system which are: urban, quasi-urban, agricultural forest, quasi-agricultural and national environment conservation zones.
3. Alternatively, the use or a willingness-to-accept (WTA) measure rather than WTP measure can be considered. Two aspects of this choice were investigated. First, designing successful willingness-to-accept (WTA) CV questions is not easy, as Mitchell and Carson (1989) indicated. This is because CV studies using WTA questions have consistently received a large number of protest answers, such as 'I refuse to sell' or "I want an extremely large or infinite amount of compensation for agreeing to this". There is much evidence that WTA values are considerably larger than the WTP values for the same provision of public goods. Secondly, there are grounds for believing that a WTP measure is the correct format for valuing decreases in the level of provision of a large class of public goods that is thought to require a WTA measure (Mitchell and Carson, 1989, pp. 37–38). Therefore, most CV studies have used a WTP question format rather than a WTA question format. In addition, Arrow *et al.* (1993) recommend the use of a conservative design that can increase the reliability of the WTP estimate for policy and damage assessment. For these reasons, this study employed a WTP question format.
4. For the purpose of meeting expenses necessary for urban planning projects, the urban planning tax is currently being imposed on land or buildings except for public facilities located in the urban planning zone and collected by a head of the local government by *Article 235, Amended by Act No. 4995, 1995* (Ministry of Legislation, 2001).
5. Alternatively, the WTP-function approach to DC-CV models, which focuses on the difference in cost functions has been discussed by Cameron and James (1987) and Cameron (1988). The choice between the Hanemann and Cameron approaches is a matter of style as much as of known defects or merits and the two approaches are dual to each other (McConnell, 1990). For this reason, the statistical analysis in this study is implemented only by using the Hanemann approach.
6. Given that 78.8 per cent of respondents stated a 'no' answer, an anonymous referee kindly suggested estimating a spike model, as suggested by Kriström (1997), to deal with the sizeable number of 'no' responses. However, there was no significant difference between the mean WTP from the spike model and the truncated mean in Table 7. This was also the case for Hanemann and Kriström (1995) and Yoo and Kwak (2002). As Hanemann and Kriström (1995) pointed out, this result can be interpreted as indicating that computing the truncated mean WTP provides a reasonable approximation to obtaining the mean WTP from the spike model. Thus, the estimation results of the spike model are not reported here to save space.
7. In order to explore the sensitivity of the WTP estimates to functional form assumptions, a non-parametric estimation approach, as proposed by Kriström (1990), has been applied without assuming any functional forms. The non-parametrical truncated mean WTP is computed to be 2992 won, which is quite similar to the parametric truncated mean WTP (2989 won). Therefore, it does not appear that the WTP estimates are sensitive to functional form assumptions. The detailed discussions on the computation of the non-parametric truncated mean WTP are omitted here for brevity.

8. The procedures of the non-parametric bootstrapping method are as follows:
   (1) creating multiple simulated data-sets, each formed by sampling N times with replacement from actual data;
   (2) applying maximum likelihood to these simulated data;
   (3) computing the welfare measures from a new set of coefficient estimates;
   (4) repeating the above procedures with M replications sufficient to generate an empirical distribution for the welfare measures; and
   (5) computing the confidence intervals using M welfare measures (Efron and Tibshirani, 1993).
9. Total benefits were calculated based on the mean WTP estimate (C^{+}) because the truncated mean (C^{++}) unambiguously overstates the true mean in situations where the intercept is greater than zero—i.e. when the probability of acceptance at a zero bid is greater than 0.5 (Hanemann, 1989). In other words, an inconsistency arises because the domain of the fitted cumulative density in a linear model with a logistic distribution is theoretically allowed to include all the real numbers, even though the random variable is known *a priori* to exclude negative values.
10. The Korea National Statistical Office (2001) reports that there were 2 417 126 households in Seoul in 2000.

References

ARROW, K., SOLOW, R. P., PORTNEY, R. *ET AL.* (1993) Report of the NOAA Panel on contingent valuation, *Federal Register*, 58, pp. 4601–4614.

BANISTER, D. (1999) Urban sustainability, in: J. C. J. M. VAN DEN BERGH (Ed.) *Handbook of Environmental and Resource Economics*, pp. 560–568. Cheltenham: Edward Elgar.

BISHOP, R. C. and HEBERLEIN, T. A. (1979) Measuring values of extra-market goods: are indirect measures biased?, *American Journal of Agricultural Economics*, 61, pp. 926–930.

BRENT, R. J. (1995) *Applied Cost–Benefit Analysis*. Cheltenham: Edward Elgar.

CAMERON, T. (1988) A new paradigm for valuing non-market goods using referendum data: maximum likelihood estimation by censored logistic regression, *Journal of Environmental Economics and Management*, 15, pp. 355–379.

CAMERON, T. and JAMES, D. (1987) Efficient estimation methods for 'closed-ended' contingent valuation surveys, *Review of Economics and Statistics*, 69, pp. 269–276.

COOPER, J. C. (1994) A comparison of approaches to calculating confidence intervals for benefit measures from dichotomous choice contingent valuation surveys, *Land Economics*, 70, pp. 111–122.

EFRON, B. and TIBSHIRANI, R. J. (1993) *An Introduction to the Bootstrap*. New York: Chapman and Hall.

FISHER, A. (1996) The conceptual underpinnings of the contingent valuation method, in: D. J. BJORNSTAD and J. R. KAHN (Eds) *The Contingent Valuation of Environmental Resources*, pp. 19–37. Cheltenham: Edward Elgar.

GREEN, C. H. and TUNSTALL, S. M. (1999) A psychological perspective, in: I. J. BATEMAN and K. E. WILLIS (Eds) *Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation Method in the US, EU and Developing Countries*, pp. 207–257. Oxford: Oxford University Press.

GREY, G. and DENEKE, F. (1978) *Urban Forestry*. New York: Wiley.

HANEMANN, W. M. (1984) Welfare evaluations in contingent valuation experiments with discrete responses, *American Journal of Agricultural Economics*, 66, pp. 332–341.

HANEMANN, W. M. (1989) Welfare evaluations in contingent valuation experiments with discrete responses: reply, *American Journal of Agricultural Economics*, 71, pp. 1057–1061.

HANEMANN, W. M. and KRISTRÖM, B. (1995) Preference uncertainty, optimal designs and spikes, in: P.-O. JOHANSSON, B. KRISTRÖM and K.-G. MÄLER (Eds) *Current Issues in Environmental Economics*, pp. 58–77, Manchester: Manchester University Press.

KLING, C. and SEXTON, R. (1990) Bootstrapping in applied welfare analysis, *American Journal of Agricultural Economics*, 72, pp. 406–418.

KOREA NATIONAL STATISTICAL OFFICE (2001) *Korea Statistical Yearbook 2001*. Taejeon, Korea.

KRINSKY, I. and ROBB, A. (1986) On approximating the statistical properties of elasticities, *Review of Economics and Statistics,* 68, pp. 715–719.

KRISTRÖM, B. (1990) A non-parametric approach to the estimation of welfare measures in discrete responses valuation studies, *Land Economics*, 66, pp. 135–139.

KRISTRÖM, B. (1997) Spike models in contingent valuation, *American Journal Agricultural Economics*, 79, pp. 1013–1023.

LAHTI, P. and RAUHALA, K. (1994) *Infill of suburban areas: possibility, costs and savings*. VTT Research Notes 1574, VTT, Espoo.

LOOMIS, J. (1996) Measuring the economic benefits of removing dams and restoring the Elwha River: results of a contingent valuation survey, *Water Resources Research*, 32, pp. 411–447.

McCONNELL, K. E. (1990) Models for referendum data: the structure of discrete choice models for contingent valuation, *Journal of Environmental Economics and Management*, 18, pp. 19–35.

MILLER, R. W. (1997) *Urban Forestry: Planning and Managing Urban Green Spaces*. Englewood Cliffs, NJ: Prentice-Hall.

MINISTRY OF CONSTRUCTION AND TRANSPORTATION (2001) *Construction and Transportation Statistical Yearbook 2001*. Kyunggi, Korea.

MINISTRY OF LEGISLATION (2001) http://www.moleg.go.kr. Korea.

MITCHELL, R. C. and CARSON, R. T. (1989) *Using Surveys to Public Goods: The Contingent Valuation Method*. Washington, DC: Resources for the Future.

OECD (ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT) (1999) *Handbook of the Incentive Measures for Biodiversity: Design and Implementation*. Paris: OECD.

PARK, T., LOOMIS, J. and CREEL, M. (1991) Confidence intervals for evaluating benefits estimates from dichotomous choice contingent valuation studies, *Land Economics*, 67, pp. 64–73.

ROBINETTE, C. (1972) *Plants, People and Environmental Quality*. Washington, DC: Department of the Interior, National Park Service.

ROWE, R. D. and CHESTNUT, L. G. (1983) Valuing environmental commodities revisited, *Land Economics*, 59, pp. 404–410.

YOO, S.-H. and CHAE, K.-S. (2001) Measuring the economic benefits of the ozone pollution control policy in Seoul: results of a contingent valuation survey, *Urban Studies*, 38, pp. 49–60.

YOO, S.-H. and KWAK, S.-J. (2002) Using a spike model to deal with zero response data from double bounded dichotomous choice contingent valuation surveys, *Applied Economics Letters*, 9, pp. 929–932.